The PSP Bible

Rev 1.2.0 5/31/09

Disclaimer

Only a small part of the information found in this document has been personally uncovered by myself; the majority of the information has been heavily plagiarized from a variety of online sources. It is not my intention that this information be regarded as my own original work, but rather as an original compilation of the information I have collected into a single, consolidated, organized and easily digested reference source for the homebrew and modding community.
I hope that you find it useful.
Senti
4/30/2009

PSP Product Specifications

For simplicity's sake, all of the hardware specs and schematics used in this document are (when known) based on the PSP 1001's (Phat) TA-079 motherboard and related components.

Product Name: PlayStation Portable (PSP)
Color: Black
Dimensions: Approx. 170 mm (L) x 74 mm (W) x 23 mm (D)
Weight: Approx. 260 g (including battery)
Processors:

- Sony CXD1876 (Media Engine Chip) – MIPS R4000 Family CPU
  - 333 MHz (Maximum). 222 MHz (Preset Default)
  - 2MB embedded RAM
- Sony CXD2962GG (Graphics Processor Chip) – MIPS R4000 Family CPU
  - 166 MHz (Maximum). 111 MHz (Preset Default)

- 2MB embedded RAM (Video Memory) Main Memory: 32MB

Main Memory:

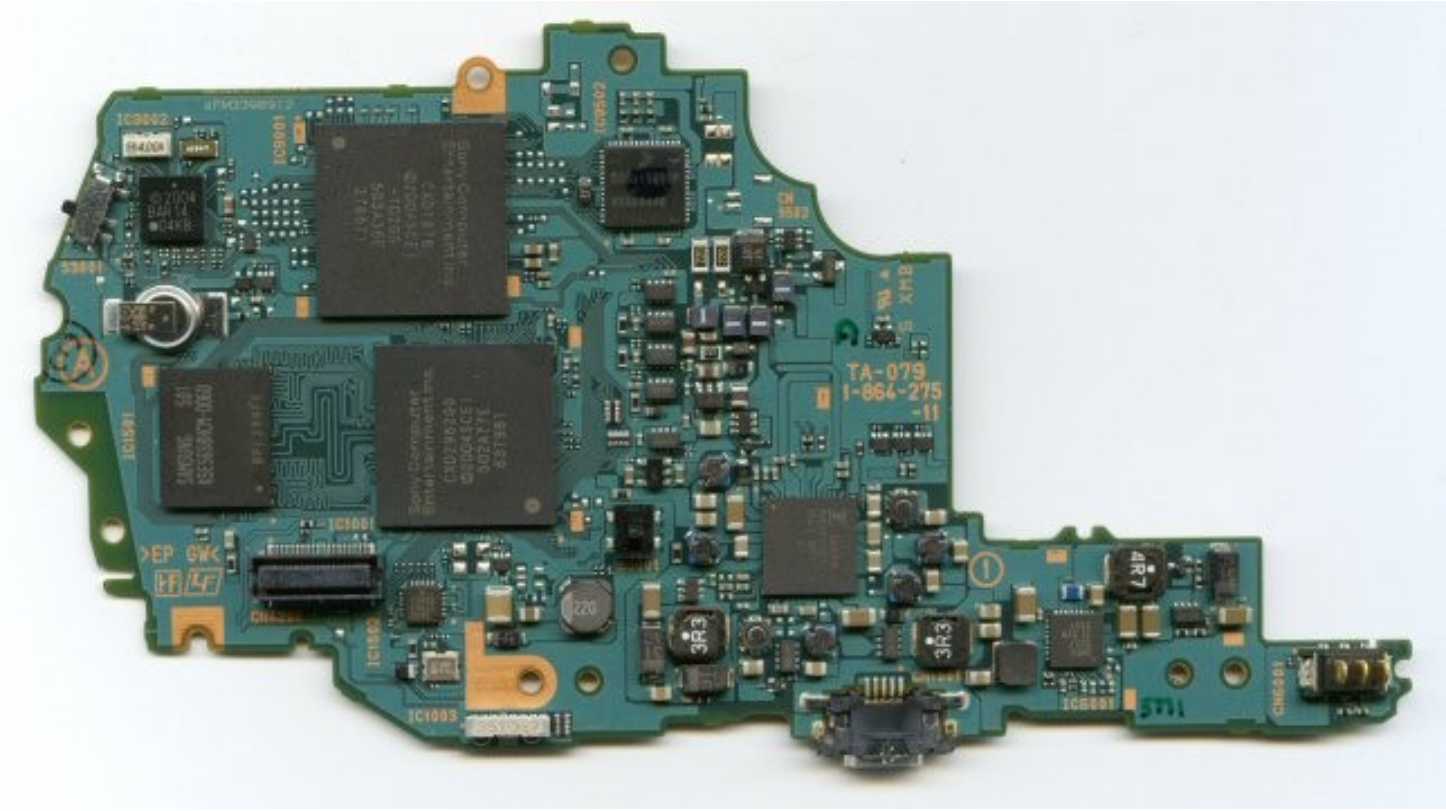
- Samsung K5E5658HCM-D060
- 32MB 333MHz DDR SDRAM memory

Embedded DRAM: 4MB
Display: Sharp 4.3 inch, 16:9 widescreen TFT LCD, 480 x 272 pixel (16.77 million colors), Max. 200 cd/m2 (with brightness control)
Speakers: Built-in stereo speakers
Main Input/Output: IEEE 802.11b (Wi-Fi), USB 2.0 (Target), Memory Stick™ PRO Duo, IrDA, IR Remote (SIRCS)
UMD Disc Drive: (Playback only)

- **Dimensions**: Approx. 65 mm (W) x 64 mm (D) x 4.2 mm (H)
- **Weight**: Approx. 10g
- **Disc Diameter**: 60 mm
- **Maximum Capacity**: 1.8GB (Single-sided, dual layer)
- **Laser wavelength**: 660nm (Red laser)
- **Encryption**: AES 128bit
- **Profile**: PSP Game (full function), UMD Audio (codec ATRAC3plus™, PCM, (MPEG4 AVC)), UMD Video (codec MPEG4 AVC, ATRAC3plus™, Caption PNG)

Main Connectors: DC OUT 5V, Terminals for charging built-in battery, Headphone/Microphone/Control connector
Power: Built-in lithium-ion battery, AC adaptor

Motherboard Components – Side A



CN1001

USB 2.0 mini-B connector.

CN4201

Memory stick reader / WiFi Network/ Sound circuit board (**MS-268**) connector.

CN6001

3-pin battery connector.

CN9502

No component present – test points.

CRYSTAL CLOCK OSCILLATOR

27.000 (MHz) by NDK (Nihon Dempa Kogyo Co., LTD). 27 MHz crystal oscillator. Probably NDK part# NX3225SA or similar.

IC1001

CXD2962GG by Sony. Graphics processor chip, codename *TACHYON*.

The main '*S*ystem *O*n a *C*hip' (SoC) IC. A Sony custom-made LSI which holds the main CPU (ALLEGREX), the VFPU coprocessor, the Media Engine CPU & its embedded DRAM, the Graphics Engine & its embedded DRAM, the AVC decoder, the Virtual Mobile Engine DSP, the KIRK & SPOCK crypto engines, and the 4KB embedded mask ROM which holds the PreIPL and routines to boot into service mode.

IC1003

IRDA (infrared) sensor array.

IC1501

K5E5658HCM by Samsung. Flash/SDRAM.
MCP 3.0V/2.5V 32MB 8 bit Uniform Block NAND Flash + 32MB 32 bit 6ns CL3 DDR SDRAM in a 137 ball FBGA(LF) package. (Firmware storage)

IC1502

27043 by (unknown).
Possibly for clock signal conversions.

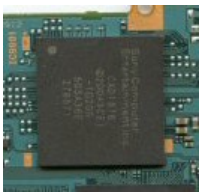
IC3002

BAR14 by Sony. SYSCON microcontroller, codename *BARYON*.
64 pin BGA chip. Handles everything from controlling power to all devices (including the LCD, UMD drive, memstick, WLAN, and main cpu), keeping the date/time, sleep mode control, controls all external switches including all buttons & the analog nub as well as the headphone remote buttons/switches, LED control, main power & battery control, and even access to the PSP's Service Mode (SYSCON is the chip responsible for detecting the 0xFFFFFFFF serial of the battery to enable service mode).

IC6001

SN105257 by Texas Instruments. Possibly a type of voltage regulator or controller.

IC9001



CXD1876 by Sony. Media engine, codename *LEPTON*.
This Sony custom-made LSI holds the optical media DSP & CPU (Mechacon UMD Controller), the ATAPI interface, 480KB DRAM read buffer, and (at least) 384KB Flash ROM for firmware.

IC9502

SC901583EP by Freescale Semiconductors (Motorola).

Unlabled IC

MB44C001 by Fujitsu. DC/DC power converter, codename *POMMEL*.
Power convertor IC controlled by the SYSCON (*BARYON* / **BAR14**) microcontroller.

S3001

WLAN switch.

S9001

UMD detect switch.

SYSCON CMOS Battery

By Matsushita Electric Industral Corp (Panasonic).

SYSCON 4 MHz Ceramic Resonator

[M] 4.00B by Matsushita Electric Industral Corp (Panasonic).
4 MHz ceramic resonator with built in capacitors (30 pF). Pin1=IN, Pin2=Gnd, Pin3=OUT.
Mfg part# EFO-SS4004E5 or similar. NOTE: there is a second chip, A507Y, next to the 4 MHz resonator. This second chip is a crystal 32.768 KHz.

Motherboard Components – Side B

CN2503

Left side speaker connector.
NOTE : The speaker Audio Power Amplifier (small IC in picture next to connector) appears to be a 6-pin BGA chip made by Texas Instruments, part TPA2010D1 or similar. The chip is marked as “AKO”, which designates the package as lead-free solder.

CN2504

Right side speaker connector.
(See NOTE with CN2503 connector.)

CN4001

FH12A-40S-0.5SH(55) by Hirose Electric. Primary LCD ZIF connector.
The primary of two (also **CN4502**) connectors between the Sharp LCD’s flex circuit and the motherboard. Carries the display data, signal and test lines.

CN4502

Secondary LCD ZIF connector.
The secondary of two (also **CN4502**) connectors between the Sharp LCD’s flex circuit and the motherboard.
Backlight power connection.

CN4801

ABXY / power switch board (**SW-445**) ZIF connector.

CN4902

Direction control pad (d-pad) ZIF connector.

CN6002

CPL2102-0101F by SMK Corp. 2-Pin DC power jack connector.
Connects to SMK Corp part CPL2302-0101F (housing) with CTA5126-1101F (wire terminals).

CN9001

No component present – test point.

CN9501

UMD optical drive data flex cable connector.

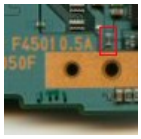
CN9503

UMD optical drive motor control flex cable ZIF connector.

F1001 1.0A

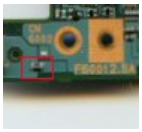
NFCC06501ADTPF by (unknown). USB port 1.0A fuse.

F4501 0.5A



NFCC06102ADTPF by (unknown). LCD 0.5A fuse.

F6001 2.5A



NFCC06252ADTPF by (unknown). Main power 2.5A fuse.

F7001 nanoSMDC050F

nanoSMDC050F by Tyco Electronics. Polyswitch 2.5A resettable fuse.

IC2501

WM8973G by Wolfson Microelectronics. Audio Stereo CODEC.
Audio driver for speakers and headphones, digital audio equalizer.

The following is for the Wolfson WM8973L, which SHOULD be a close match, but not verified - use with caution.

Pin No.	Name	Type	Description
1	MCLK	Digital Input	Master Clock
2	DCVDD	Supply	Digital Core Supply
3	DBVDD	Supply	Digital Buffer (I/O) Supply
4	DGND	Supply	Digital Ground (return path for both DCVDD and DBVDD)
5	BCLK	Digital Input / Output	Audio Interface Bit Clock

6	DACDAT	Digital Input	DAC Digital Audio Data
7	DACLRC	Digital Input / Output	Audio Interface Left / Right Clock/Clock Out
8	ADCDAT	Digital Output	ADC Digital Audio Data
9	ADCLRC	Digital Input / Output	Audio Interface Left / Right Clock
10	MONOOUT	Analogue Output	Mono Output
11	OUT3	Analogue Output	Analogue Output 3 (can be used as headphone Pseudo Ground)
12	ROUT1	Analogue Output	Right Output 1 (Line or Headphone)
13	LOUT1	Analogue Output	Left Outpu 1 (line or headphone)
14	HPGND	Supply	Supply for Analogue Output Drivers (LOUT1/2, ROUT1/2)
15	ROUT2	Analogue Output	Right Output 1 (Line or Headphone or Speaker)
16	LOUT2	Analogue Output	Left Output 1 (Line or Headphone or Speaker)
17	HPVDD	Supply	Supply for Analogue Output Drivers (LOUT1/2, ROUT1/2, MONOUT)
18	AVDD	Supply	Analogue Supply
19	AGND	Supply	Analogue Ground (return path for both AVDD)
20	VREF	Analogue Output	Reference Voltage Decoupling Capacitor
21	VMID	Analogue Output	Midrail Voltage Decoupling Capacitor
22	MICBIAS	Analogue Output	Microphone Bias
23	RINPUT3 / HPDETECT	Analogue Input	Right Channel Input 3 or Headphone Plug-in Detection
24	LINPUT3	Analogue Input	Left Channel Input 3
25	RINPUT2	Analogue Input	Right Channel Input 2
26	LINPUT2	Analogue Input	Left Channel Input 2
27	RINPUT1	Analogue Input	Right Channel Input 1
28	LINPUT1	Analogue Input	Left Channel Input 1
29	MODE	Digital Input	Control Interface Selection
30	CSB	Digital Input	Chip Selection / Device Address Selection
31	SDIN	Digital Input / Output	Control Interface Data Input / 2-wire Acknowledge Output
32	SCLK	Digital Input	Control Interface Clock Input

IC4503

L00053B by National Semiconductor. Dual-Display Constant Current LED Driver with Analog Brightness Control.
Manufacturer part# LM3503. A dual-display white LED driver used for display backlighting applications, the LM3503 has cycle-by-cycle current limit, output over-voltage protection, input under-voltage protection, and dynamic white LED current control capability.

Note : Pins are counted counter-clockwise from pin 1 mark.

Pin No.	Name	Description
DAP	DAP	Die Attach Pad (DAP), to be soldered to the printed circuit board's ground plane for enhanced thermal dissipation.
1	NC	No Connection
2	Sw	Drain Connection of the Power NMOS Switch
3	Sw	Drain Connection of the Power NMOS Switch
4	Vout1	Over-Voltage Protection (OVP) and Source Connection of the PMOS FET Switch
5	NC	No Connection
6	Vout2	Drain Connections of the NMOS and PMOS Field Effect Transistor (FET) Switches. (Connect 100nF at VOUT2 node if VOUT2 is not used)
7	Fb	Connect 100nF at VOUT2 node if VOUT2 is not used
8	NC	No Connection
9	Cntrl	White LED Current Control Connection
10	En1	PMOS FET Switch Control Connection
11	NC	No Connection
12	En2	NMOS FET Switch Control Connection
13	Vin	Input Voltage Connection
14	Agnd	Analog Ground Connection
15	Pgnd	Power Ground Connection
16	Pgnd	Power Ground Connection

Cntrl : White LED current control pin. Use this pin to control the feedback voltage with an external DC voltage.

Fb : Output voltage feedback connection.

VOUT2 : Drain connections of the internal PMOS and NMOS FET switches (*Figure 1*: P1 and N2). It is recommended to connect 100nF at VOUT2 if VOUT2 is not used.

VOUT1 : Source connection of the internal PMOS FET switch and OVP sensing node. The output capacitor must be connected as close to the device as possible, between the VOUT1 pin and ground plane. Also connect the Schottky diode as close as possible to the VOUT1 pin to minimize trace resistance and EMI radiation.

Sw : Drain connection of the internal power NMOS FET switch. Minimize the metal trace length and maximize the metal trace width connected to this pin to reduce EMI radiation and trace resistance.

Pgnd : Power ground pin. Connect directly to the ground plane.

Agnd : Analog ground pin. Connect the analog ground pin directly to the Pgnd pin.

VIN : Input voltage connection pin. The CIN capacitor should be as close to the device as possible, between the VIN pin and ground plane.

En2 : Enable pin for the internal NMOS FET switch during device operation. When VEn2 is ≥ 1.4V, the internal NMOS FET switch turns off and the SUB display is turned on. The En2 pin has an internal pull down circuit, thus the internal NMOS FET switch is normally in the on state of operation with the SUB display turned off. When VEn2 is ≤ 0.3V, the internal NMOS FET switch turns on and the SUB display is turned off. If both VEn1 and VEn2 are ≤ to 0.3V the LM3503 will shutdown. If VOUT2 is not used, En2 must be floating or grounded and En1 used to enable the device.

En1 : Enable pin for the internal PMOS FET switch during device operation. When VEn1 is ≤ 0.3V, the internal PMOS FET switch turns on and the MAIN display is turned off. When VEn1 is ≥ 1.4V, the internal PMOS FET switch turns off and the MAIN display is turned on. If both VEn1 and VEn2 are ≤ 0.3V the LM3503 will shutdown. The En1 pin has an internal pull down circuit, thus the internal PMOS FET switch is normally in the on state of operation with the MAIN display turned off. If VOUT2 is not used, En2 must be grounded and En1 use to enable the device.

IC6003

No component present.
It is unknown if this location is used as a set of test points or if it is an unused IC location held over from a prior motherboard design. The layout for an 8 pin SMD IC suggests the latter possibility.

IC9501

A2707G by Sony.

Sub Assemblies / Daughter Boards / Misc

Analog Nub Controller

DC Power Jack

LCD

Sharp 4.3 inch, 16:9 widescreen TFT LCD, 480 x 272 pixel (16.77 million colors), Max. 200 cd/m2 (with brightness control).

TFT LCD Panel

Connects via **CN4001**.

Term No.	Name	Function	Notes
1	GND	GND (0V)	
2	GND	GND (0V)	
3	VCC	+2.5V power source	
4	VCC	+2.5V power source	
5	R0	RED data signal (LSB)	
6	R1	RED data signal	
7	R2	RED data signal	
8	R3	RED data signal	
9	R4	RED data signal	
10	R5	RED data signal	
11	R6	RED data signal	
12	R7	RED data signal (MSB)	
13	G0	GREEN data signal (LSB)	
14	G1	GREEN data signal	
15	G2	GREEN data signal	
16	G3	GREEN data signal	
17	G4	GREEN data signal	
18	G5	GREEN data signal	
19	G6	GREEN data signal	
20	G7	GREEN data signal (MSB)	
21	B0	BLUE data signal (LSB)	
22	B1	BLUE data signal	
23	B2	BLUE data signal	
24	B3	BLUE data signal	
25	B4	BLUE data signal	
26	B5	BLUE data signal	
27	B6	BLUE data signal	
28	B7	BLUE data signal (MSB)	
29	GND	GND (0V)	
30	CK	Clock signal to sample each data	
31	DISP	Display ON / OFF signal	
32	Hsync	Horizontal synchronizing signal	
33	Vsync	Vertical synchronizing signal	

34	NC	NC	Note 1
35	AVDD	+5V Analog power source	
36	AVDD	+5V Analog power source	
37	NC	NC	Note 1
38	TEST1	TEST1	Note 2
39	TEST2	TEST2	Note 3
40	TEST3	TEST3	Note 3

Note 1 - They have been open within FPC.
Note 2 - Please be sure to set 38 pins (TEST1) to open.
Note 3 - Please be sure to connect 39 pin (TEST2) ,40 pin (TEST3) with GND.

LCD Backlight

Connects via **CN4502**.

Term No.	Signal	Function
1	Vled-	LED Power Source Input terminal (Cathode side)
2	NC	NC
3	NC	NC
4	Vled+	LED Power Source Input terminal (Anode side)

Left Speaker

Connects to motherboard, side B, via **CN2503** connector.

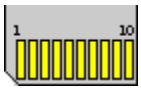
MS-268

Memory Stick reader, WiFi submodule, and headphone/remote control port.
Connects to motherboard, side A, via **CN4201** connector.

WiFi submodule

SWU-BXJ154N
Mounted on the underside of the SIRCS / memory stick submodule.
Marvell Libertas 88W8010 (RF transceiver)
Marvell Libertas 88W8380 (ARM9 processor)

Memory Stick



Pin No.	Name	Function
1	VSS	
2	BS	(IN) serial protocol bus state signal
3	VCC	(IN)
4	DIO	(IN/OUT) serial protocol data signal
5	not used	
6	INS	stick insertion/extraction detect
7	not used	
8	SCLK	(IN) serial protocol clock signal
9	VCC	
10	VSS	

Headphone / Remote Control Port

Standard 3.5mm 3-conductor stereo headphone jack and 6-pin female control port.

Phone jack:

Tip (pink wire) : left audio (plus 600mv DC bias)
Ring (red wire) : right audio
Sleeve (black wire) : audio ground (GND)

6-pin female control port

(pin numbered clockwise from top left pin)
Pin 1 : (brown wire) ? Possibly ground (GND)
Pin 2 : (blue wire) digital ground (GND)
Pin 3 : (orange wire) TXD
Pin 4 : (green wire) ? Possibly trigger @2.5V (seems to be control from PSP itself)
Pin 5 : (yellow wire) +2.5V (0V when plug isn't inserted into headphone jack)
Pin 6 : (grey wire) RXD

Right Speaker

Connects to motherboard, side B, via **CN2504** connector.

Unlabeled Connection

Analog Nub controller contact/connection point to motherboard, side B.

UMD drive

Glossary

ALLEGREX (part of TACHYON)
The codename for the main cpu of the PSP. Codename origin unknown.

BARYON (another Star Trek term)
The codename for the SYSCON microcontroller IC (refer to SYSCON for more information). (IC marked with “BAR xx”).

HIBARI
The codename for the PSP Slim LCD Controller IC. Means “Skylark” in Japanese.

IdStorage
A low-level storage area that holds specific configuration data and id’s for each individual PSP. A basic mapping format is used where a single NAND page is used to store a “leaf”. Each leaf is assigned a 16-bit leaf id and mapped to an index. Located in the first MB non-mapped area of the NAND Flash. 256KB is reserved on the flash to hold the IdStorage area.

IPL (Initial Program Load)
The bootstrap program that loads the firmware. Located in the first MB non-mapped area of the NAND Flash. 512KB is reserved on the flash to hold the IPL.

KIRK (part of TACHYON) (another Star Trek term)
The hardware crypto engine responsible for almost all aspects of the PSP’s security, including decryption of eboots & prx’s, savefile and adhoc encryption, and idstorage verification. Named after Captain Kirk of Star Trek.

LEPTON (another Star Trek term) *chip CXD1876*
The codename for the Mechacon UMD Controller IC. A Sony custom-made LSI which holds the optical media DSP & CPU, the ATAPI interface, 480KB DRAM read buffer, and (at least) 384KB Flash ROM for firmware.

Magpie
The codename for the PSP Fat’s WLAN firmware (bird name also used for the codename of the PSP Slim’s LCD Controller IC: “Hibari” – means Skylark).

NAND
Refers to NAND Flash. A type of non-volatile memory similar to an EEPROM which uses NAND Gate cells (as opposed to NOR Flash which uses NOR Gates). On the PSP, a single MCP IC holds both the NAND Flash and DDR SDRAM both of which are 32MB in size (on the slim PSP both are doubled to 64MB and embedded into the TACHYON main CPU IC). The NAND Flash holds the entire PSP Firmware as well as the IPL and IdStorage.

POMMEL (another Star Trek term) *chip MB44C001*
The codename for the Power Control IC. A DC-DC converter controlled by SYSCON.

PBP (PSP Boot Package)
The file extension for eboots used to launch programs under the VSH. Holds the ELF executable file as well as optional icon/background/sound files to visually display under the VSH.

PRX (PSP Relocatable Executable)
A custom relocatable ELF file used as the executable file format for PSP programs. Typically used as library modules in the PSP firmware. Similar to the IRX (IOP Relocatable Executable) or ERX (EE Relocatable Executable) of the PS2 executable formats.

PSAR (Playstation Archive)
An archiving file format used to store an image of the PSP's firmware. Used by firmware updaters to update the PSP's firmware.

Psjs (Playstation Javascript)
A javascript-like scripting language used to drive the XMB and its resources.

SPOCK (part of TACHYON) (another Star Trek term)
The hardware crypto engine responsible for the raw sector level decryption of UMD's. Named after Captain Spock of Star Trek.

SYSCON (codename BARYON)
The System Control microcontroller which handles everything from, controlling power to all devices (including the LCD, UMD drive, memstick, wlan, even the main cpu), keeping the date/time, sleep mode control, controls all external switches including all buttons & the analog nub as well as the headphone remote buttons/switches, LED control, main power & battery control, and even access to the PSP's Service Mode (SYSCON is the chip responsible for detecting the 0xFFFFFFFF serial of the battery to enable service mode).

TACHYON (another Star Trek term) *chip CXD2962GG*
The codename for the main CPU SoC IC. A Sony custom-made LSI which holds the main CPU (Allegrex), the VFPU coprocessor, the Media Engine CPU & its embedded DRAM, the Graphics Engine & its embedded DRAM, the AVC decoder, the Virtual Mobile Engine DSP, the KIRK & SPOCK crypto engines, and the 4KB embedded mask ROM which holds the PreIPL and routines to boot into service mode.

Voyager (another Star Trek term)
The codename for the PSP Slim's WLAN firmware. Named after the Starfleet vessel of Star Trek.

VSH (Visual Shell)
The main interface of the PSP, a user interface shell which provides the access to the kernel. Uses Sony's XMB (Cross Media Bar) for its GUI.

XMB (Cross Media Bar)
The graphical component of the VSH. A script driven GUI first developed for the Sony Japanese PSX DVR (Digital Video Recorder) and also used on Sony WEGA & Bravia TV's as well as the Sony PS3.

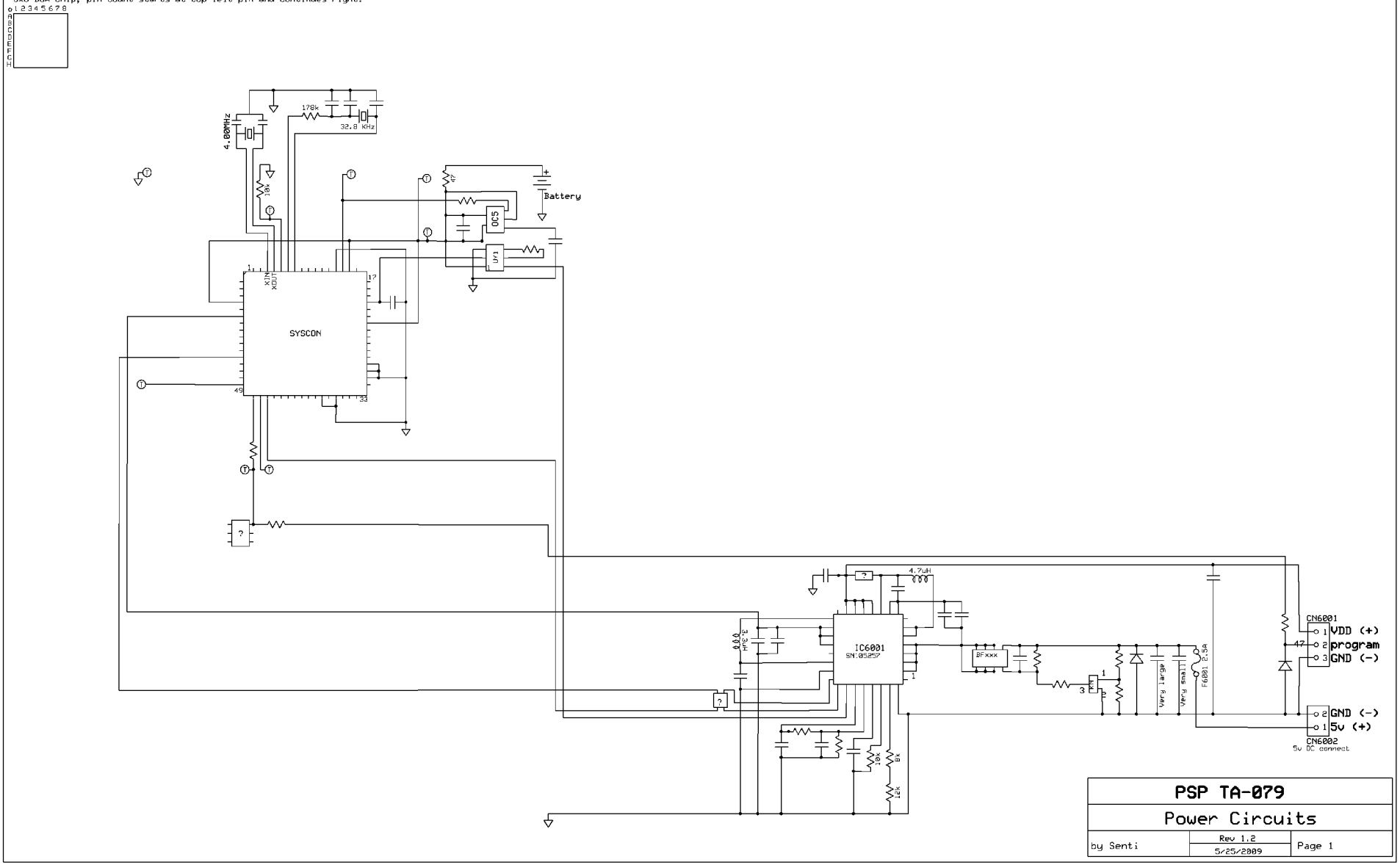
Circuit Schematics

The PSP TA-079 motherboard (not including sub-boards) contains 4 proprietary IC's made by Sony itself and 7 other IC's produced for Sony by other companies. None of the Sony produced chips have publically available datasheets and only 2-3 of the non-Sony produced chips have so far been identified as being based on known production chips with publically available datasheets. Because so much of the critical chip circuitry of the PSP is unknown (and will probably stay that way for the foreseeable future), any schematic produced by the user community is doomed to contain a great deal of omissions and errors, so use them with caution.

These schematics will be updated as new information is obtained:

Power Circuits – updated 5/31/09

8x8 BGA chip, pin count starts at top left pin and continues right.



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Power Circuits		
by Senti	Rev 1.2 5/25/2009	Page 1

Useful Links and Credits

In writing this document, I have found useful information in more places than I can realistically recall, but a couple places really stand out.

Acidmods.com http://acidmods.com/
Probably THE best mod site on the internet (and since I'm the one writing this document, my opinion's the one that counts), if you have a hardware question about the PSP, this site is your best bet on finding help.

Dark-Alex http://www.dark-alex.org/
One of the finest custom firmware (CFW) site on the internet.

Hitman Group http://hitmen.c02.at/
Home of a great PSP guide called *'yet another PlayStationPortable Documentation'*. It hasn't been updated in a while but it's full of useful information and can be found at http://hitmen.c02.at/files/yapspd/psp_doc/index.html#idx3.5/

The Llamma's adventures in Sony PSP http://www.llamma.com/PSP/index.html
A good site for repair parts and guides (with lots of pictures).

SBORPS (SilverSpring's Bunch Of Random PSP Stuff) http://my.malloc.us/silverspring/
The name says it all, but you can find a lot of great PSP developer-type information on this site.